CLAIMS

WHAT IS CLAIMED IS:

1. A laser confocal scanning microscope comprising:

means, including a laser light source, for emitting laser light beams at different wavelengths;

a beam path for directing said laser light beams from said laser light beam emitting means to an object stage for supporting an object, said beam path including

a first deflector including an acousto-optical deflector for effecting line scanning, at least one objective for focussing the laser light beams onto the object on said object stage,

a second deflector positioned between said acousto-optical deflector and said at least one objective for effecting frame scanning, said second deflector and said at least one objective being positioned so that return light beams from the object follow the same beam path as the laser light beams focussed onto the object up to and including the second deflector,

at least one detector positioned in the return light beam path downstream said second deflector for detecting the return light beams from the object, the object being adapted to be scanned by the laser light beams from the laser light beam emitting means and measurements being adapted to be made with said at least one detector in order to obtain images of the object, and

an electronic control and imaging system adapted to control the laser light beam emitting means to emit laser light beams of different selected wavelengths and adapted to dynamically adjust drive parameters of said acousto-optical deflector in accordance with the selected wavelength of the laser light beams, to maintain alignment of the scan lines of the image at all wavelengths.

2. A laser confocal scanning microscope comprising:

means, including a laser light source, for emitting laser light beams at different wavelengths;

a beam path for directing said laser light beams from said laser light beam emitting means to an object stage for supporting an object, said beam path including

a first deflector including an acousto-optical deflector for effecting line scanning,

at least one objective for focussing the laser light beams onto the object on said object stage,

a second deflector positioned between said acousto-optical deflector and said at least one objective for effecting frame scanning, said second deflector and said at least one objective being positioned so that return light beams from the object follow the same beam path as the laser light beams focussed onto the object up to and including the second deflector,

at least one detector positioned in the return light beam path downstream said second deflector for detecting the return light beams from the object, the object being adapted to be scanned by the laser light beams from the laser light beam emitting means and measurements being adapted to be made with said at least one detector in order to obtain images of the object, and

an electronic control and imaging system adapted to control the laser light beam emitting means to emit laser light beams of different selected wavelengths and adapted to dynamically adjust the optical path by mechanical means in accordance with the selected wavelength of the laser light beams, to compensate for astigmatism and collimation changes due to the change in input beam wavelength and adapted to modify the obtained images of the object by electronic means to maintain alignment of the scan lines of the image at all wavelengths.

3. The laser confocal scanning microscope according to claim 2, further comprising:

a mirror positioned to direct the incident light into the input aperture of the said acousto-optical deflector, the mirror and acousto-optical deflector being mounted and arranged so that they may rotate about the central axis of the acousto-optical deflector, and said electronic control and imaging system is adapted to dynamically adjust drive parameters of said acousto-optical deflector and pivot said mirror and said acousto-optical deflector in accordance with the selected wavelength of the laser light beams, to maintain alignment of the scan lines of the image at all wavelengths.

4. The laser confocal scanning microscope according to claim 2, said mechanical means comprising a movable astigmatism lens and/or a movable collimating lens placed in said beam path.

5. The laser confocal scanning microscope according to claim 2, said beam path further including:

a lens positioned between said objective and the second deflector to direct the light beams from said objective onto said second deflector, and

at least one spatial filter positioned in the return light beam path between said second deflector and said at least one detector for effecting confocal imaging,

whereby a frame-scanning movement introduced by said second deflector is adapted to be eliminated as a result of which the return light can be focussed on said at least one spatial filter.

6. The laser confocal scanning microscope according to claim 2, wherein a first beam splitter or dichromatic mirror is incorporated in the beam path between said acousto-optical deflector and said laser light beam emitting means so as to split off the return light beam and to direct it to said at least one detector, wherein said beam path is constructed such that the return light beam follows the same optical path as the laser light beam up to said first beam splitter or dichromatic mirror whereby the line scanning movement introduced by said acousto-optical deflector is eliminated.

7. The laser confocal scanning microscope according to claim 2, for use in fluorescence microscopy or other forms of microscopy in which the wavelength of the return beam differs from that of the laser light beams emitted from said laser light beam emitting means, wherein a spatial filter is mounted on an assembly of three piezoelectric crystals and can accordingly be moved in a 3D co-ordinate system, as a result of which the effect of the dispersive nature of the acousto-optical deflector on the return light of a different wavelength, which is deflected through an angle other than the reflected laser light, is eliminated and wherein a correspondingly matched bandpass or cut-off filter is incorporated in the return light beam path to filter out the reflected laser light.

8. The laser confocal scanning microscope according to claim 2 for use in fluorescence or other forms of microscopy in which the wavelength of the return beam differs from that of the laser light beam, wherein a dichromatic mirror is incorporated in the beam path between the acousto-optical deflector and the second deflector in order to deflect the return light beam with differing wavelengths downstream of the second deflector and to direct it via an objective and a subsequent spatial filter to a subsequent detector, the subsequent spatial filter being a slit filter which forms a line detector with the subsequent detector.

9. The laser confocal scanning microscope according to claim 8, wherein the return light beam is adapted to be divided into a plurality of light beams by means of an

additional beam splitter or dichromatic mirror or a plurality of additional beam splitters or dichromatic mirrors inserted into the return beam path after the return beam path is separated from the input beam path by the first beam splitter or dichromatic mirror, each resulting beam is adapted to be directed to one or more detectors, each detector having a spatial filter, objective, and lens duplicating the single detector beam path, except that a bandpass or cut-off filter may be different for each detector.

10. The laser confocal scanning microscope according to claim 1, wherein said electronic control and imaging system is adapted to provide synchronisation of the selected laser light beam wavelength to the flyback or other selected time point in the line scans by applying control signals to a wavelength selection means mounted downstream of said laser light source such that the laser light beams passing through said wavelength selection means on their passage into or through the beam path are controlled such that only the selected wavelength is permitted to pass through the beam path.

11. The laser confocal scanning microscope according to claim 1, wherein said electronic control and imaging system is adapted to provide synchronisation of the intensity modulation or blanking of the laser light source beam to the flyback or other selected time point in the line scans by applying control signals to an intensity modulation means mounted downstream of said laser light source such that the laser light beams passing through said intensity modulation means on their passage into or through the beam path are controlled such that the intensity of the light beams can be modulated or blanked.

12. The laser confocal scanning microscope according to claim 10, wherein said wavelength selection means comprises an acousto-optical tuneable filter (AOTF).

13. The laser confocal scanning microscope according to claim 11, wherein said intensity modulation means comprises an acousto-optical tuneable filter (AOTF) and/or said acousto-optical deflector.

14. The laser confocal scanning microscope according to claim 1, wherein said electronic control and imaging system is comprised of hard wired logic, a Digital Signal Processor, a microprocessor, a computer or a similar computational device.

15. The laser confocal scanning microscope according to claim 1, wherein said laser light source includes a multi-line laser, a tuneable laser, and/or an array of lasers emitting at various wavelengths and an optical configuration that provides collinear laser beams.

16. The laser confocal scanning microscope according to claim 1, wherein said second deflector comprises a mirror galvanometer.

17. The laser confocal scanning microscope according to claim 1, wherein the light beams are coupled to the beam path by means of a rigid or flexible optical light guide.

18. The laser confocal scanning microscope according to claim 17, wherein the optical light guide is an optical fibre.

19. A method of achieving fast multi-wavelength scanning in an acousto-optical deflector based laser confocal scanning microscope, comprising:

dynamically adjusting drive parameters of said acousto-optical deflector in accordance with a selected wavelength of a laser light beam, to maintain alignment of scan lines of an image of an object at all wavelengths.

20. A method of achieving fast multi-wavelength scanning in an acousto-optical deflector based laser confocal scanning microscope, comprising:

dynamically adjusting an optical path of said an acousto-optical deflector based confocal microscope by mechanical means in accordance with a selected wavelength of a laser light beam, to compensate for astigmatism and collimation changes due to the change in input beam wavelength and modifying detected images of an object by electronic means to maintain alignment of the scan lines of the image at all wavelengths.

21. A method of achieving fast multi-wavelength scanning in an acousto-optical deflector based laser confocal scanning microscope according to claim 19, further comprising:

mechanically pivoting of the acousto-optical deflector about its central axis to compensate for the different deflection angles and ranges of the used illumination wavelengths.